ably, a particular oxidant may appear in several contexts, but it is at once a fascinating feature of the book and a tribute to its sound construction that a theme, appropriately introduced, recurs with expanding significance in subsequent chapters. Always the emphasis is on mechanism, derived whenever possible from the results of kinetic or isotopic studies, and discussed with a proper regard for the importance of its stereochemical implications. But of all the pleasing features of this monograph none is more praiseworthy than the splendid choice of illustrative material. This is drawn, with complete disregard for artificial boundaries, from organic and inorganic chemistry and from biochemistry alike; and by its broad perspectives gives new meaning even to the more familiar topics. Present-day developments, specific applications and, above all, interpretation of enzyme behaviour in terms of chemical models, enrich and instruct throughout.

Dr. Waters is to be congratulated. He should count as his grateful readers all organic chemists, and all biologists too, who seek to understand the organic chemist's point of view. Truly a notable book! J. D. LOUDON

SHAPING METALS BY EXPLOSIVES

Explosive Working of Metals

By Prof. John S. Rinehart and John Pearson. Pp. viii + 351. (London and New York: Pergamon Press, 1963.) 100*s*. net.

DURING the last quarter of the nineteenth century, and extending into the first quarter of this one, the effect of explosives on metals was largely the concern of the suppliers of military equipment, who were for ever battling to produce armour-piercing shells of greater penetrating power, and more resistant armour to render them ineffective. Initially these developments concerned the heavily armoured battleships equipped with heavy guns, but later the tank and the aerial bomb appeared, requiring rather less heavy armour in the first case and different conditions of penetration in the latter. During the Second World War, the new weapon, in the shape of the nuclear bomb, still retained some use of conventional explosives, but for a different purpose. Explosive working is taken to cover shaping, cutting, joining, and the possible changes in metallurgical and engineering properties of material, by use of explosive energy.

One of the earliest civil applications of explosive working was that of the engraving of iron plates. In more recent times, pressings of generally shallow curvature in heavy section steel plates were carried out at least in part by explosive forming. Only in the past decade, however, has the development spread to many industrial forming operations, largely owing to the demand from the space and missile field. The reduction of structural weight is of the utmost importance to both aircraft and space vehicles, and in the latter category, improvement in the power-to-weight ratio largely determines the advances made in rocketry, whether for civil or military purposes. The essential factor here is the production of a thin shell of high-strength material, often with complex curvatures and changes in section. The best techniques of forming from rolled sheet cannot provide the requisite strength and shape without expensive non-destructive testing and handworking operations. Explosive forming can fabricate, in one operation, the complete component, with the maximum strength and retention of properties.

Explosive forming is not confined to sheet metal, but can be carried out on plate, powder compacts, or billets. Many of the newer metals and alloys, for which there was no background knowledge of the fabrication concerned, could not be shaped into more complex components without welding, or other methods of joining, the separate portions. Explosives can form and weld such materials, many of which have very high melting points. From an economic point of view, the cost of this new technique may prove much less than conventional methods (in spite of the obvious precautions which must be taken), particularly where one-off or short runs of components are involved. The knowledge gained from conventional techniques is not wasted with respect to forming by explosives; in fact, the most successful of the new methods have often been developed from the old.

The authors of this volume divide their approach into two parts, the physical basis and the engineering fundamentals and practice. In each case, the two ends of the spectrum of operations, stand-off and contact, are dealt with separately. Stand-off refers to the separation of the charge and workpiece by an intervening medium such as air, oil, or water. In contact operations, the charge is in intimate contact with the material to be formed. Such operations still fall largely into the realm of development. Variations in pressure result from the two types of application, and, in addition, the shock waves transmitted also affect the mode of deformation of the material. An understanding of these effects is largely the purpose of this book, and presumes a prior knowledge of plastic flow and fracture behaviour, including the effect on microstructure.

The study of shock waves, their distribution, reflexion, and structural effects, is quite a fascinating story, well illustrated with diagrams and photographs in this particular case. The increase in yield stress of a metal which results from deformation under rapid rates of straining can be illustrated in terms of the ductility of mild steel. Elongation in the annealed condition, roughly 70 per cent, is lowered to about 15 per cent under a pressure of 3 million lb./in.^{2}. The more ductile materials, particularly pure metals, suffer less change in ductility. Transformation changes in alloys have been shown to be affected by explosive charges, particularly in iron and steel. (Similar changes in meteorites have been investigated in the light of these reports.) The future potential of explosive working is covered in the final chapter, together with an appraisal of the appropriate place of the technique in industrial processes. It appears that, in ten years, the new method has progressed from odd experiments with 'ditching dynamite' to regular production work with high explosives of the type used in military operations.

This technique of explosive working promises to be not only a most important step forward for the future development of fabricated metal components, but is also likely to add to metallurgical understanding in the realm of high strain rate deformation, and this new volume makes an excellent introduction to the subject.

C. R. TOTTLE

THE BIOCHEMIST AND THE ENGINEER

Biochemical Engineering

By Dr. F. C. Webb. Pp. viii + 743. (London: D. Van Nostrand Company, Ltd.; Princeton, N.J.: D. Van Nostrand Company, Inc., 1964.) 120*s*.

WHO could be better suited to write a book with this title than the first Guinness lecturer in biochemical engineering at University College, London? The inevitable result of the ever-widening spheres of knowledge within each scientific discipline, so far as text-book writing is concerned, has been the production of works composed of chapters written by a variety of specialist authors. On these grounds it might be contended that the work now under review cannot be adequate and that its two dozen chapters should have been contributed by nearly as many authors. But would it not, in this instance, have been an admission of defeat? Biology, so long a cock-shy as an 'inexact' science, has